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Caring for Precious Cargo, Part I: Emergency Aircraft Evacuations With Infants Onto Inflatable Escape Slides

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16. Abstract

Purpose. Twenty-nine survivable aircraft accidents between 1970 and 1995 required the emergency evacuation of 67 infants. Thirty-four percent of the infants received minor to fatal injuries. With the exception of full-scale Type Certifications in which infant dolls are included but not studied, simulated emergency evacuations and evacuation research rarely include infants and young children. The purpose of this study was to determine the most favorable protocol for the evacuation of infants via an inflatable emergency evacuation slide. **Method.** Simulated emergency evacuations were conducted from the Civil Aerospace Medical Institute Aircraft Evacuation Facility, using a Type I exit fitted with a Boeing 737 evacuation slide. Six groups of 32 adult evacuees participated in six evacuation trials. Eight evacuees in each group carried one of eight dummies representative of infants ranging from two to 24 months old. On the first and last trials, no instructions were given as to how the dummies should be carried or how to board the slide. The intervening trials included instructions to carry the dummy horizontally or vertically and to jump onto the slide or sit on the slide to board. Results were analyzed with respect to speed of egress relative to the effects of the carrying and boarding positions. Subject responses to a questionnaire regarding comfort and safety were also analyzed. **Results.** For speed of egress, MANOVA revealed a main effect for slide boarding ($p<.001$), with no effect for carrying position and no interaction effects. Subjects reported that jumping onto the slide was easier than sitting to board the slide. **Conclusions.** Results confirmed the expectation that jumping onto the evacuation slide would produce faster egress rates than sitting and sliding while carrying an infant. Results also suggested that appropriate carrying and boarding positions would be those most comfortable for the *parent* and those providing support for the child's head and neck.

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Caring for Precious Cargo, Part I: Emergency Aircraft Evacuations With Infants Onto Inflatable Escape Slides

Safety is one of the highest goals of public transportation. To that end, several modal administrations of the Department of Transportation (DOT), including the Federal Aviation Administration (FAA), have organized public conferences, entitled *Moving Kids Safely*, designed to promote injury-prevention activities for children. The program has become a national initiative aimed at educating America's communities in child transportation safety. In 1999, FAA Administrator Jane Garvey committed the FAA to "making air travel safer for everyone—young and old alike...assuring that children are accorded the same level of safety in aircraft as are adults." Garvey also stated that the FAA would mandate the use in transport airplanes of approved child restraint systems for small children and infants under 40 pounds (Garvey, 1999). This followed several years of accident and incident investigations, including cabin safety and biodynamics research.

Garvey's statement responds to a recommendation made by the White House Commission on Aviation Safety and Security and follows an Advance Notice of Proposed Rulemaking ([ANPRM] DOT, 1998) that was issued by the FAA in February 1998. According to the ANPRM, the proposed rule would ensure that "each passenger is properly restrained by an approved restraint system during movement on the surface, take-off, landing, and when the seat belt sign is illuminated, thereby increasing the safety of the traveling public. In addition, the proposed rule would require affected certificate holders to develop a child restraint program to ensure that all children under 40 pounds are in an approved child restraint system."

In May 1995, the FAA submitted a report to Congress that estimated infant enplanements to be approximately 1% of all passenger enplanements, based on a combination of air carrier surveys, industry experience, and a sampling of passengers. Applying this rate, the FAA estimated 80 million infant enplanements for the 10-year period 2000-2009 (DOT, 1998). Additionally, a review of accident/incident biomedical data collected by the Civil Aerospace Medical Institute (CAMI) identified 29 transport aircraft accidents between 1970 and 1995 that required the evacuation of 67 infants. Thirty-four percent of those children received minor to fatal injuries: no injuries were reported for 44 infants, six infants received minor injuries, nine infants received serious injuries, and eight infants received fatal injuries. Applying the historic accident rate forecasts an increase in infant fatalities and injuries by as much as 46% for the referenced10-year period.

In its effort to ensure one level of safety for every occupant in an aircraft, the FAA has also questioned how adults with infants evacuate airliners when emergencies occur. With the exception of full-scale Type Certifications in which infant dolls are included but not studied, simulated emergency evacuations and evacuation research rarely include infants and young children. Thus, few data exist regarding this issue. A review of the evacuation literature found only one report (Garner & Blethrow, 1966) that specifically addressed the rescue of infants and children between the ages of 2 and 24 months. Furthermore, the National Transportation Safety Board [NTSB] has recommended that the FAA "...[r]eview air carriers' procedures to ensure that for those situations in which crews anticipate an eventual evacuation, adequate guidance is given both to pilots and flight attendants on providing passengers with precautionary safety briefings" (NTSB, 2000). A telephone survey of major airlines regarding emergency evacuation procedures with infants revealed that, in general, there are no recommended procedures. A briefing for a course of emergency action beyond recommended brace positions for an impact is not standardized nor described in most flight attendant emergency procedures manuals. One airline's manual does specify that an adult carrying a small child or infant should jump onto the evacuation slide, arms locked around the child, who is cradled on the adult's lap.

To address the gaps in these minimal findings, preliminary demonstrations were conducted at CAMI to gather information on the best ways of safely evacuating small children from a crashed airplane (Chittum, 1998). While these performance observations and interviews

with subjects participating in the evacuation demonstrations were useful, they did not address the risk of injury to infants being carried by adults, or the effects of egress with infants on safe and efficient egress of other passengers during emergency aircraft evacuations.

The present study was conducted to address these issues. The information obtained from this study is intended for use in developing pre-evacuation briefings. This first phase of the study examined evacuations using a Type I exit fitted with a Boeing 737 evacuation slide. A follow-up phase will include evacuations via the Type III overwing exit.

The hypothesis was that jumping onto the evacuation slide facilitates faster egress than does sitting and is more comfortable (or easier) for boarding, as was observed in the 1998 demonstrations. The age/size of the dummy was expected to affect the preferred carrying orientation, as larger dummies appeared more likely to cause the person carrying them to lose his or her balance.

METHOD

Subjects

Six groups of 32 adult evacuees participated in the evacuation trials: four groups of U.S. Air Force and Navy personnel attending egress training at CAMI under a Memorandum of Agreement between the Department of Transportation and the Department of Defense (DOT, 1994a, 1994b) and two groups of airline industry representatives attending CAMI Cabin Safety Workshops. Twenty-seven males and 21 females, ranging in age from 18 to 43 (mean age = 29.32 years; eight subjects from each group), were selected to carry an anthropomorphic dummy on six evacuation trials. Twenty-five of the infant carriers were parents.

Materials

Eight dummies, representative of 2- to 24-month-old infants, were used. Table 1 summarizes the anthropometry for infants and children, newborn through 42 months, and Table 2 lists the measurements of the dummies used in this study.

A demographics survey was used to screen members of the military and workshop groups for potential infant carriers, based on the subjects' stated physical abilities, willingness to participate, and required gender mix for the sample. All group members were required to provide informed consent in accordance with CAMI Institutional Review Board policy.

The CAMI Aircraft Cabin Evacuation Facility (ACEF), elevated to a sill height of 9 ½ feet, (with a 5° left roll, and 3° up-pitch) was used for the simulated evacuations conducted through the right front Type I exit. On the first and last trials, no instructions were given as to how the dummies should be carried or how to board the slide. The four intervening trials included individual instructions printed on index cards to carry the dummy horizontally or vertically and to jump onto the slide or sit on the slide to board (i.e., vertical/jump, vertical/sit, horizontal/jump, horizontal/sit). Typical carrying orientations are illustrated in Figures 1 through 4. Additionally, the aircraft cabin was filled with theatrical smoke on the last trial. All evacuation trials were videotaped and time-coded for subsequent analysis.

A questionnaire was used to measure the subject's perceived degree-of-ease of each carrying/boarding maneuver. Subjects were also asked which maneuver they considered to be the most comfortable and the most safe, and which maneuver they would recommend to parents. Additional comments were solicited (see Appendix A).

Procedure

Demographic surveys were distributed to the military and workshop groups as they arrived for class. The completed surveys were screened for potential subjects to carry the infant dummies, and eight infant carriers from each subject group were selected.

Following the classroom presentation, numbered vests were distributed to all members of the subject groups, and infant dummies were given to those selected to be infant-carriers. Subjects were escorted to the ACEF and directed to sit in the seat that corresponded with their vest number. Each group evacuated the simulator twice before the experiment began, once in clear air and once in smoke, without infant dummies, in fulfillment of military training and workshop activities.

For the first experimental trial, infant carriers were instructed to hold the infant dummies on their laps and to evacuate carrying the dummies when the start buzzer sounded. A member of the research team acted as the "flight attendant," removing the door cover at

Table 1. Infant Anthropometry

Age in months	Mean Weight/kg	s.d.	Weight range/lb	Mean Length/cm	s.d.	Length range/in
0 – 2	5.1	1.1	8.82 - 13.67	56.3	3.9	20.64 - 23.71
3 – 5	6.9	1.0	13.00 - 17.42	63.1	3.6	23.42 - 26.26
6 – 8	8.1	0.9	15.88 - 19.84	68.5	2.6	25.95 - 27.99
9 – 11	9.2	1.1	17.85 - 22.71	73.0	3.3	27.44 - 30.04
12 – 15	10.1	1.2	19.62 - 24.92	76.5	3.2	28.93 - 31.45
16 – 19	10.6	1.2	20.72 - 26.02	79.2	3.4	29.84 - 32.52
20 – 23	11.5	1.5	22.04 - 28.66	82.6	4.0	30.92 - 34.08
24 - 42	14.1	1.9	26.89 - 35.27	93.4	5.0	34.80 - 38.74

Source: UM-HSRI-77-17, Anthropometry of infants, children, and youths to age 18 for product safety design, Final Report, May 31, 1977. Highway Safety Research Institute, The University of Michigan, Ann Arbor, Michigan 48109. Richard G. Snyder PhD, Lawrence W. Schneider PhD, Clyde L. Owings MD PhD, Herbert M. Reynolds PhD, D. Henry Golomb MS, M. Anthony Schork PhD.

Table 2. Dummy measurements

Dummy number	Weight/lb	Length/in	Estimated age representation
1	10.91	16.75	2 months
2	10.51	16.75	2 months
3	17.04	24.50	6 months
4	18.06	26.00	6 months
5	24.76	33.00	18 months
6	25.65	31.00	18 months
7	28.96	31.00	24 months
8	29.92	31.00	24 months

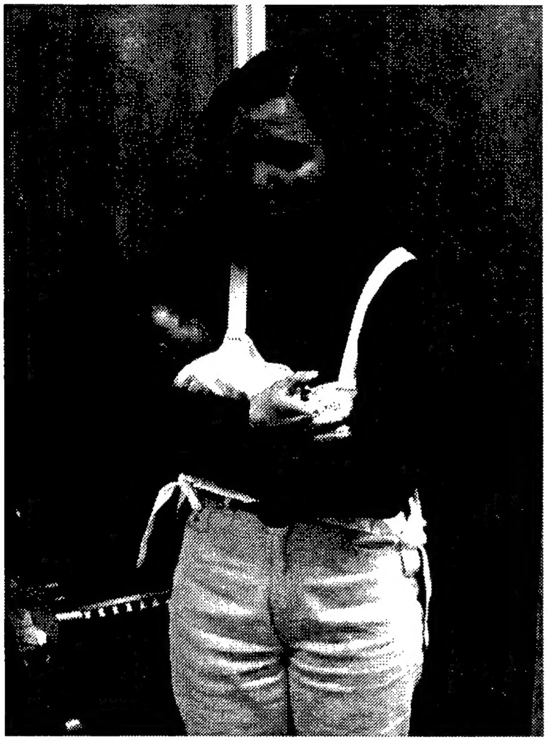

Figure 1. 2-month infant dummy held horizontally.

Figure 2. 18-month infant dummy held vertically.

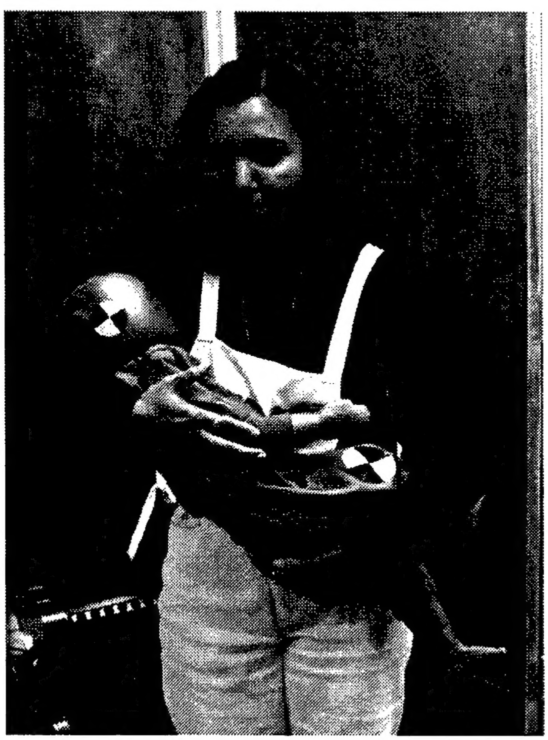

Figure 3. 18-month infant dummy held horizontally.

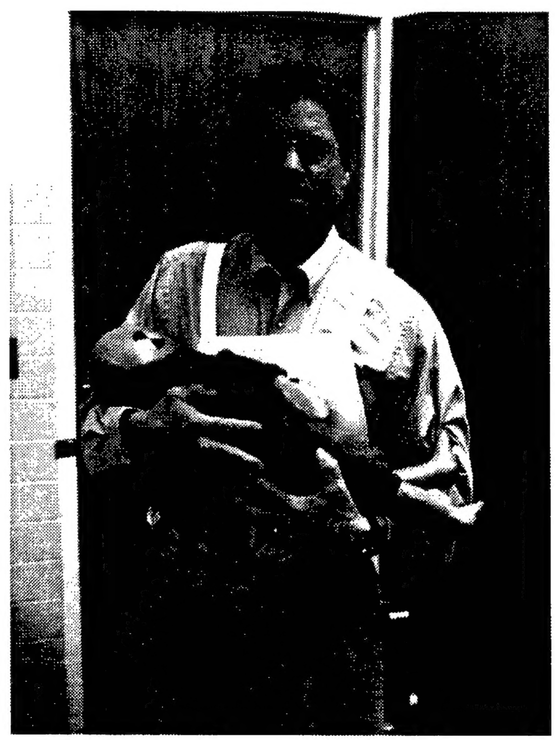

Figure 4. 6-month infant dummy held horizontally.

the start signal and aggressively encouraging the quick evacuation of the plane. Subjects reboarded, were seated, and given the instruction cards that described how to carry the infant dummy and how to board the evacuation slide. Each infant carrier received a different instruction for each of the four instruction card trials. On the last (sixth) trial, smoke was introduced into the cabin, but no instructions were given as to carrying and boarding maneuvers.

Following the evacuation trials, infant carriers completed the carrying/boarding maneuvers questionnaire.

Scoring

Speed-of-egress data. The video recordings were reviewed to obtain individual egress times, these being defined as the time it took for a subject to completely clear the exit opening after the previous subject was clear.

Degree-of-ease data. Degree-of-ease was assessed for each carrying/boarding maneuver on a continuous scale labeled "Very difficult" on the left and "Very easy" on the right. Infant carriers were instructed to mark an "X" on the line that corresponded with the ease of the maneuver. The distance from the "Very difficult" end was measured in increments of eighths of an inch, with the higher score representing a higher degree of ease.

RESULTS

Prior to analysis, the egress time and questionnaire data were examined for accuracy of data entry, missing values, and fit between their distributions and the assumptions of multivariate analysis. Normality of sampling distributions, homogeneity of variance, and linearity were considered to be acceptable.

The speed-of-egress data were analyzed with a 2 x 2 x 2 x 4 (Subject Gender x Carrying Orientation x Boarding Maneuver x Dummy Size) multivariate analysis of variance (MANOVA), with carrying and boarding serving as repeated measures. A significant main effect of Boarding Maneuver was obtained (see Figure 5), $F(1, 40) = 173.4$, $p < .001$, which accounted for 81% of the variance (η^2). There were no interaction effects and no other main effects (see Table 3). Jumping onto the evacuation slide gave significantly faster egress than sitting on the slide to board. When the military groups were compared with the workshop groups (Group Type x Carrying Orientation x Boarding Maneuver x Dummy Size), the main effect of Boarding was still evident, $F(1, 40) = 159.8$, $p < .001$, as was a Group Type main effect, $F(1, 40) = 7.07$, $p = .01$ ($\eta^2 = .15$; see Table 4). The difference in the sample size did not significantly affect the statistical analysis, as the observed power was .74. The military subjects were quicker at boarding the slide than the workshop attendees for both the jumping and sitting maneuvers, with jumping onto the slide significantly quicker overall (see Figure 6). Individual mean egress times and standard deviations (collapsed across Dummy Size) are listed in Tables 5 and 6.

Degree-of-ease data were analyzed in the same manner as speed of egress. MANOVA (Subject Gender x Carrying Orientation x Boarding Maneuver x Dummy Size) confirmed a significant main effect of Boarding Maneuver, $F(1, 40) = 50.62$, $p < .001$ ($\eta^2 = .56$), and revealed a significant interaction between Subject Gender and Dummy Size, $F(3, 40) = 4.26$, $p = .01$. All subjects rated jumping onto the slide as easier. Females found it easier to carry and board the slide with the 24-month dummies than did the males. This interaction (see Figure 7) accounted for 24% of the variance.

The Boarding Maneuver x Group Type x Dummy Size interaction for degree-of-ease reached statistical significance, $F(3, 40) = 3.815$, $p = .02$. Figure 8 illustrates the interaction, which shows that Workshop Groups rated sitting on the slide to board with the 18-month dummies as being significantly easier than jumping onto the slide.

Dummy size was not associated with infant carriers' choice of boarding maneuver and carrying orientation regarding comfort ($\chi^2(9) = 9.79$, $p = .37$), or safety for the infant ($\chi^2(9) = 13.86$, $p = .13$). However, dummy size was significantly associated with the boarding and orientation positions that infant carriers would recommend to parents, $\chi^2(9) = 18.00$, $p = .04$ (see Table 7). Subjects recommended the vertical and horizontal jumping maneuvers almost equally for the 2-, 6- and 24-month dummies, while they more often recommended the vertical sitting maneuver for the 18-month dummies. No other subject characteristics (e.g., gender, group type, parenthood) were significantly associated with infant carrier choices regarding the most comfortable and safest technique for infants or recommendations for carrying/boarding maneuver.

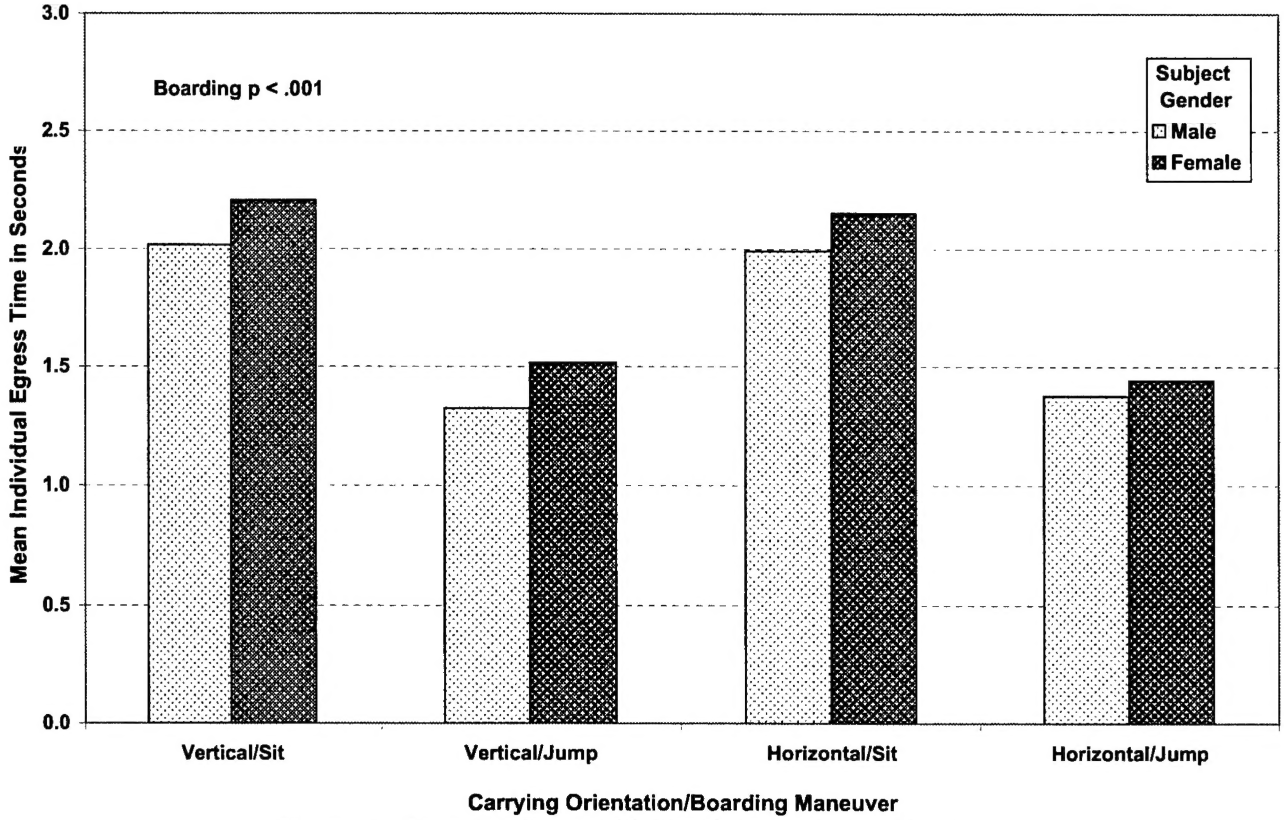

Figure 5. Speed of Egress Multivariate Analysis of Variance
Boarding Maneuver Main Effect

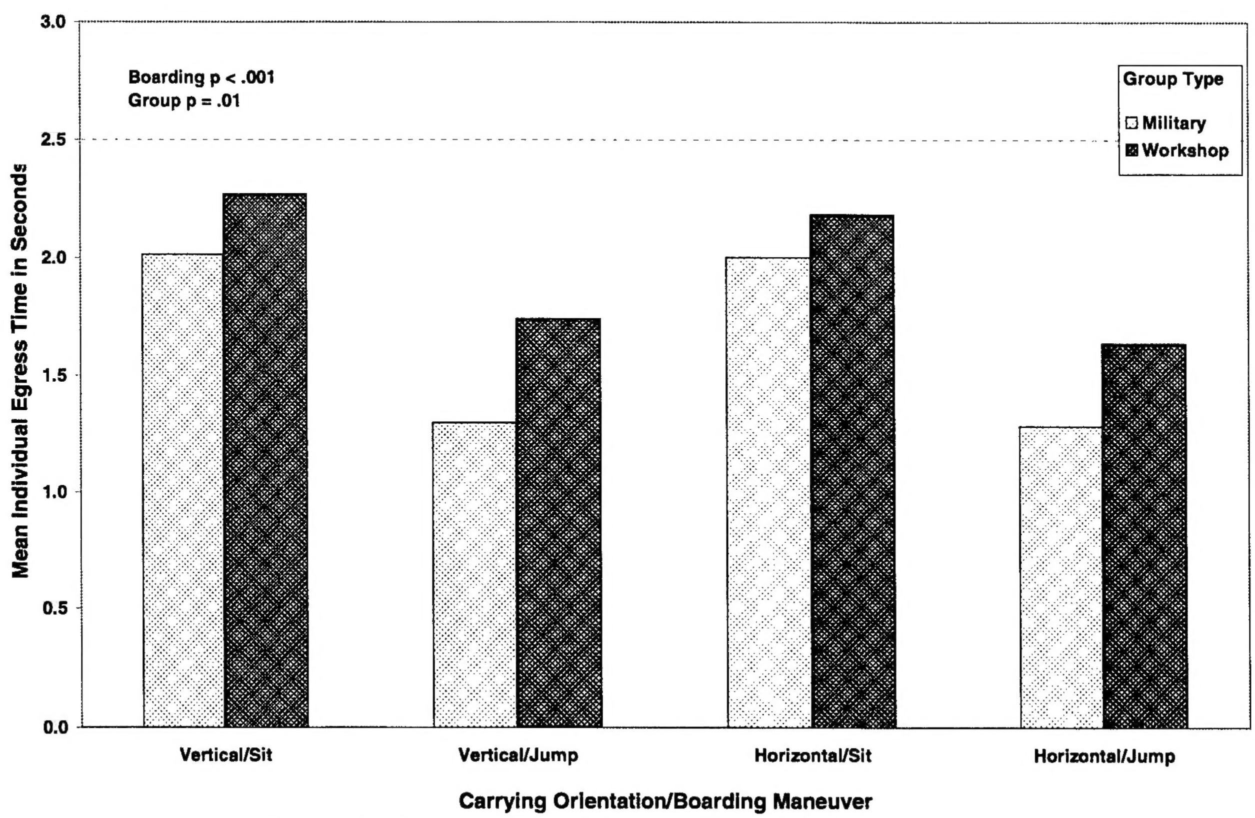

Figure 6. Speed of Egress Multivariate Analysis of Variance
Boarding Maneuver and Group Type Main Effects

Table 3. Analysis of Variance for Speed of Egress: Subject Gender x Carrying Orientation x Boarding Maneuver x Dummy Size.

Source	*df*	*F*
	Between subjects	
Dummy Size (D)	3	1.353
Subject Gender (G)	1	3.019
D x G	3	.437
Error	40	(.507)
	Within subjects	
Carrying Orientation (C)	1	.626
C x D	3	.316
C x G	1	.882
C x D x G	3	1.088
Error (C)	40	(.095)
Boarding Maneuver (B)	1	173.400**
B x D	3	.576
B x G	1	.090
B x D x G	3	1.788
Error (B)	40	(.117)
C x B	1	.453
C x B x D	3	.958
C x B x G	1	.090
C x B x D x G	3	1.950
Error (C x B)	40	(.0898)

Note. Values enclosed in parentheses represent mean square errors.

** $p < .01$.

Table 4. Analysis of Variance for Speed of Egress: Group Type x Carrying Orientation x Boarding Maneuver x Dummy Size

Source	*df*	*F*
	Between subjects	
Group Type (T)	1	7.065*
Dummy Size (D)	3	1.426
T x D	3	0.344
Error	40	(0.467)
	Within subjects	
Carrying Orientation (C)	1	0.249
C x T	1	0.045
C x D	3	0.147
C x T x D	3	0.527
Error (C)	40	(0.100)
Boarding Maneuver (B)	1	159.800**
B x T	1	1.311
B x D	3	0.736
B x T x D	3	1.682
Error (B)	40	(0.115)
C x B	1	0.259
C x B x T	1	0.266
C x B x D	3	0.600
C x B x T x D	3	.128
Error (C x B)	40	(0.102)

Note. Values enclosed in parentheses represent mean square errors.

*$p < .05$. **$p < .01$

Table 5. Individual Mean Egress Time in Seconds for Carrying Orientation and Boarding Maneuver By Subject Gender

Carrying/Boarding	Gender	Mean	*SD*	*N*
Vertical/Sit	Male	2.02	.38	27
	Female	2.21	.57	21
Vertical/Jump	Male	1.32	.28	27
	Female	1.52	.54	21
Horizontal/Sit	Male	1.99	.52	27
	Female	2.15	.45	21
Horizontal/Jump	Male	1.38	.35	27
	Female	1.44	.49	21

Table 6. Individual Mean Egress Time in Seconds for Carrying Orientation and Boarding Maneuver By Group Type

Carrying/Boarding	Group	Mean	*SD*	*N*
Vertical/Sit	Military	2.01	.41	32
	Workshop	2.27	.56	16
Vertical/Jump	Military	1.30	.32	32
	Workshop	1.62	.52	16
Horizontal/Sit	Military	2.00	.47	32
	Workshop	2.18	.52	16
Horizontal/Jump	Military	1.29	.28	32
	Workshop	1.64	.53	16

Table 7. Distribution of Responses to "Which Maneuver Would You Recommend to Parents?"

	Dummy Size				
Carrying/Boarding Maneuver	2 months	6 months	18 months	24 months	Total
Vertical/Sitting	2	0	6	0	8
Vertical/Jumping	5	6	2	5	18
Horizontal/Sitting	0	1	2	1	4
Horizontal/Jumping	5	5	2	6	18
Total:	12	12	12	12	48

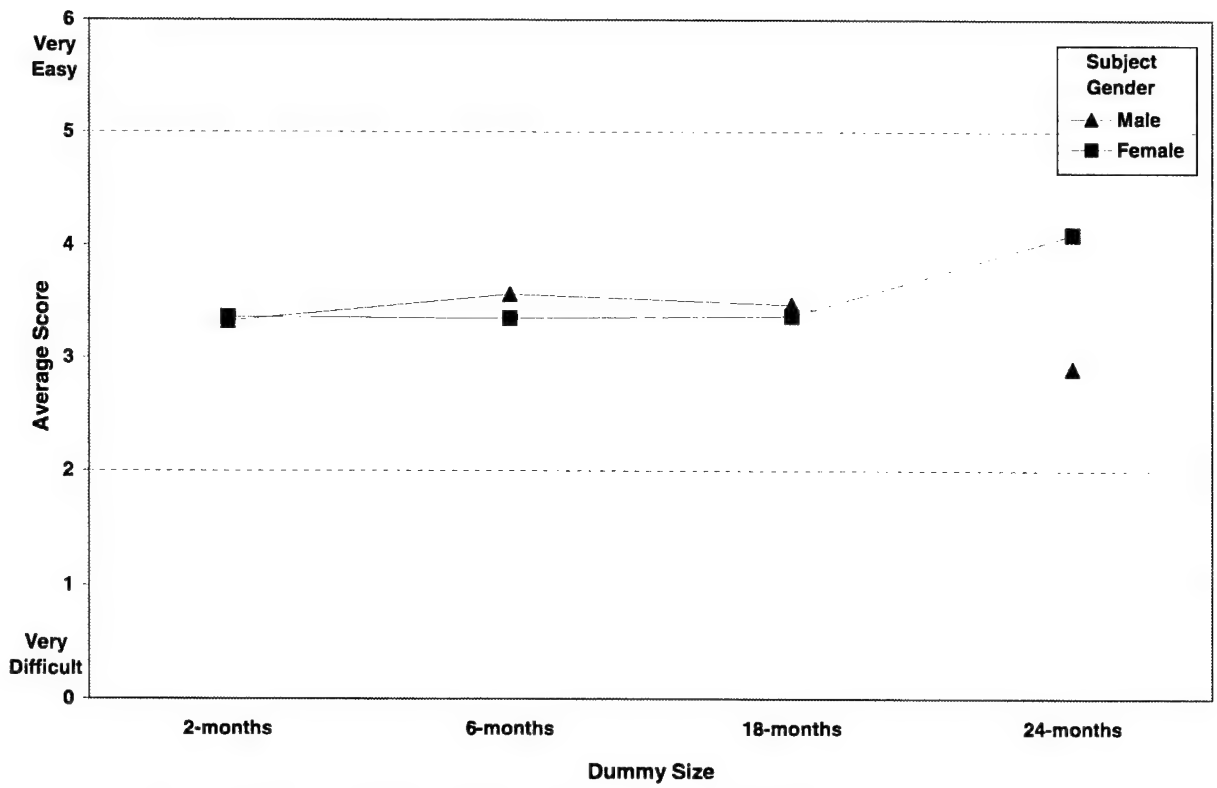

Figure 7. Degree of Ease of Carrying Orientation and Boarding Maneuvers
Subject Gender by Dummy Size Interaction

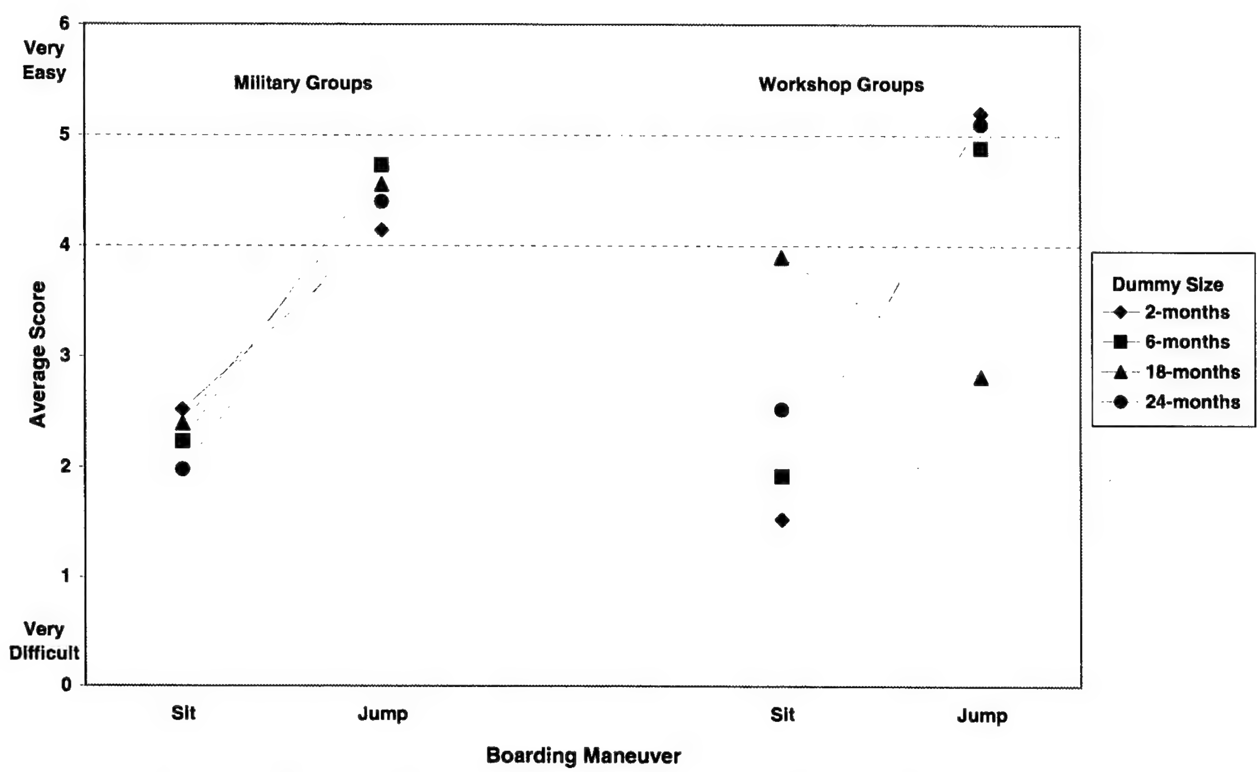

Figure 8. Degree of Ease of Carrying Orientation and Boarding Maneuvers
Boarding by Group Type by Dummy Size Interaction

Carrying orientations and boarding maneuvers from all trials are illustrated in Figures 9 through 18. On the first trial, when no instruction as to how to carry the infants or how to board the evacuation slide was given, 75% chose to carry the dummies vertically and jump onto the slide, 23% held the dummies horizontally and jumped, and 2% held the dummies horizontally and sat to board the slide. On the final trial, which included theatrical smoke in the cabin, 52% of the infant carriers held the dummies vertically and jumped, 40% held the dummies horizontally and jumped, 8% held the dummies vertically or horizontally and sat to board the slide.

Four subjects reported that they thought sitting on the evacuation slide to board would probably be safer than jumping, even though they indicated that sitting took longer and they considered it *easier* to jump. Six subjects, one for each dummy size, commented on the importance of giving support and protection to the infant's head and neck. A summary of subject comments is included in Appendix B.

DISCUSSION

An integral part of aviation safety is often the rapid evacuation of aircraft when emergencies occur. With the expected growth of air travel and increase in the number of infant and child passengers, the question of how to safely evacuate infants and children becomes even more important.

The results of this study indicate that jumping onto an evacuation slide produces faster egress than sitting and sliding, confirming the observations of the NTSB safety study (NTSB, 2000) and the 1998 infant evacuation demonstration (Chittum, 1998). Jumping was also considered to be easier than sitting to board. Some subjects described difficulty in getting to the sitting position because of people pushing them from behind, and some indicated that they had more momentum on the slide when they jumped.

Both boarding maneuvers carry some injury risk, however. Comments by subjects suggest a concern that, although sitting and sliding seemed very slow, some parents may have anxiety about jumping onto the slide while holding a child. This was shown by subjects thinking that they could better protect the child's head and neck from injury by sitting to board the slide, even though they were afraid of being trampled or thrown off balance as they attempted to sit. Figures 13 through 17 show subjects getting into the sitting position. As they put a hand out to steady themselves, they were no longer able to adequately support the dummy with their other hand.

The heightened efficiency of the military subjects, as compared with the workshop subjects, was expected, and it should be noted that the differences in efficiency were nearly equal in both boarding maneuvers. Although the workshop attendees were more familiar with evacuation procedures in general and probably had more practice at boarding an evacuation slide, they were still significantly slower than the military groups, which could be attributed to the physical fitness of the military subjects. Comments from the military subjects addressed safety issues for the infant while those from the workshop subjects focused more on the technique of slide boarding.

The 18-month dummy posed a problem for infant carriers in the workshop groups, as they rated the sitting maneuver to be easier than jumping (see Figure 8). A review of the individual responses revealed a difference in ratings between carriers of the two 18-month-size dummies. It is unclear why members of the workshop groups found it easier to sit with one dummy than the other, but their comments supported the degree-of-ease rating. If the interaction is anomalous, only the main effect of boarding maneuver remains. Their preference for the sitting maneuver may also be observed in their recommendations to parents regarding the vertical/sitting maneuver, although 38% of the military infant carriers of the 18-month dummies also recommended this strategy.

The design of this study allowed individual subjects to carry the infants and board the slide in the manner that they chose on the first trial, to experience different combinations of carrying orientation and boarding maneuvers on the next four trials, and to choose a maneuver on the final trial. Sixty-four percent of those who held the dummy vertically and 75% of those who held the dummy horizontally *jumped* onto the slide on both first and final trials. The majority of those who changed positions changed from the vertical to the horizontal orientation, but they still jumped. Only four subjects changed to the sitting position.

While statistical analysis of time and rating data may lead to a recommendation of jumping onto an escape slide, it is also critical to consider how a parent might react in an emergency. Those who are not confident in their ability to jump safely with their children onto the slide will be more likely to take the

Figure 9. Infant carrier hold 18-month dummy vertically and jumps onto slide.

Figure 10. Infant carrier hold 6-month dummy vertically and jumps onto slide.

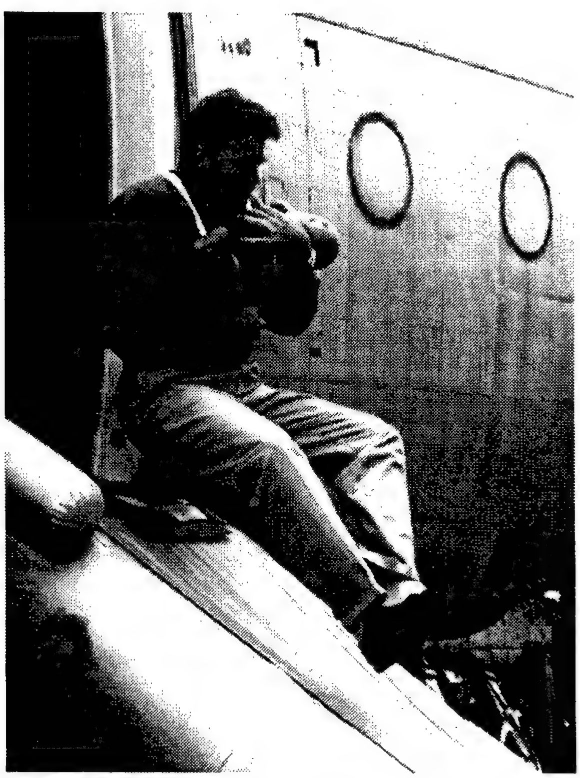

Figure 11. Infant carrier hold 18-month dummy horizontally and jumps onto slide.

Figure 12. Infant carrier hold 24-month dummy vertically and jumps onto slide.

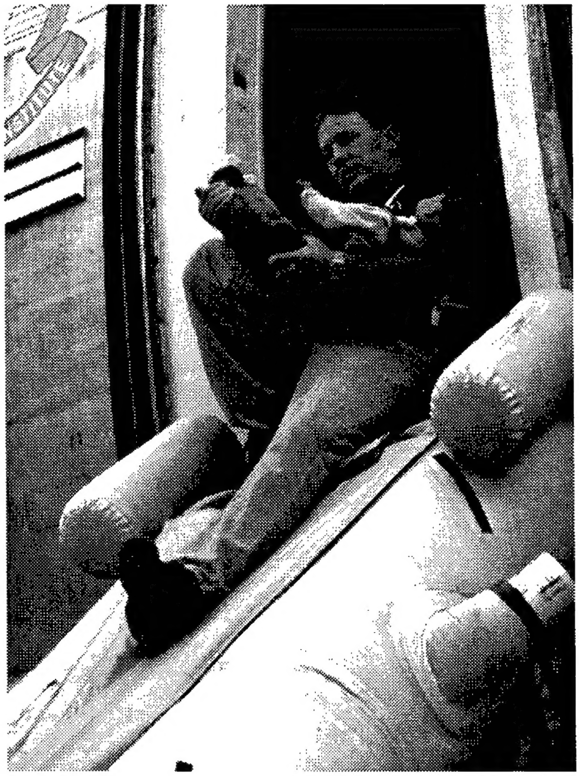

Figure 13. Infant carrier with 24-month dummy sits on slide to board.

Figure 14. Infant carrier holds 6-month dummy horizontally and sits on slide to board.

Figure 15. Infant carrier holds 24-month dummy horizontally and sits on slide to board.

Figure 16. Infant carrier steadies himself as he sits on slide to board; dummy's back is without support or protection.

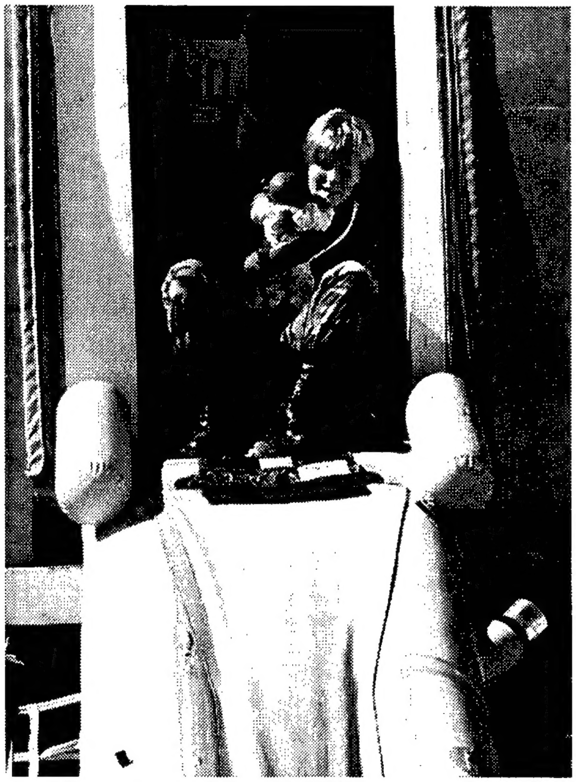

Figure 17. Infant carrier holds newborn dummy vertically with one hand while steadying herself with the other.

Figure 18. Infant carrier holds 6-month dummy vertically, supporting head, neck, and back, and jumps to board slide.

time to sit down on the slide to board, thereby slowing the progress of the evacuation. Results of this study suggest that jumping onto the slide should be the favored boarding maneuver. The carrying position should provide the most protection for the child. Protection would include cradling the child's head and neck with the hand (for vertical positions) or in the arm (for horizontal positions), and keeping the child's arms, legs, and feet enfolded as much as possible by the parent's arms. The aim, then, for an emergency evacuation briefing would be to instruct parents about properly boarding the slide to increase their confidence and proficiency.

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APPENDIX A

Emergency Aircraft Evacuations With Infants Survey

Subject number: ________________ (First and last initials, and last four digits of SSN)

Indicate the degree-of-ease or difficulty of evacuation for each maneuver by marking an "X" on the scale:

1. Holding infant *vertically*, *sitting* on slide

|____|
Very difficult   Very easy

2. Holding infant *vertically*, *jumping* onto slide

|____|
Very difficult   Very easy

3. Holding infant *horizontally*, *sitting* on slide

|____|
Very difficult   Very easy

4. Holding infant *horizontally*, *jumping* onto slide

|____|
Very difficult   Very easy

Circle your answer to the following questions:

5. Which maneuver was the most comfortable?

   a. Holding infant *vertically*, *sitting* on slide
   b. Holding infant *vertically*, *jumping* on slide
   c. Holding infant *horizontally*, *sitting* on slide
   d. Holding infant *horizontally*, *jumping* on slide

6. Which maneuver do you think is safest for the infant?

   a. Holding infant *vertically*, *sitting* on slide
   b. Holding infant *vertically*, *jumping* on slide
   c. Holding infant *horizontally*, *sitting* on slide
   d. Holding infant *horizontally*, *jumping* on slide

7. Which maneuver would you recommend to parents?

   a. Holding infant *vertically*, *sitting* on slide
   b. Holding infant *vertically*, *jumping* on slide
   c. Holding infant *horizontally*, *sitting* on slide
   d. Holding infant *horizontally*, *jumping* on slide

Remarks: ____

____

____

APPENDIX B

Summary of Subject Remarks From Emergency Aircraft Evacuations With Infants Survey

"Horizontal for small child; vertical for larger child"

"Depends on parent's comfort with jumping"

"Sitting slow and awkward"

"Worried about being trampled while sitting, though sitting seemed safest for baby"

"Less stress sitting"

"Parent would probably have anxiety over jumping; sitting took longer, but probably safer"

"Urgency should dictate sit or jump; jumping faster"

"Kept balance well holding vertically and jumping"

"Felt baby's head snap when jumping, unless instructions for support of neck/head, sit/vertical safer"

"Off balance when jumping and holding baby horizontally; almost dropped baby"

"Sitting slowed me down; prefer jumping; depending on size of child, horizontal/vertical didn't pose difference"

"Baby's leg hit on side with vertical jump"

"Vertical provided better control and balance; horizontal made head vulnerable to contact with door"

"Sitting deterred fast movement and felt unsafe"